Report of the EEA Scientific Committee. Seminar on Environment, Human Health and Well-Being

Advancing the Knowledge Base

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Publication date:
2014

Document Version
Publisher's PDF, also known as Version of record

European Environment Agency

Report of the EEA Scientific Committee Seminar on Environment, Human Health and Well-Being

Advancing the Knowledge Base

Copenhagen
12 February 2014

This report provides a summary of discussion at the European Environment Agency's Scientific Committee Seminar on 12 February 2014 in Copenhagen.

Acknowledgements

This report is based upon presentations and discussions that took place at a seminar of the European Environment Agency's (EEA) Scientific Committee, held on 12th February in Copenhagen. Seminar participants included:

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Executive Summary

This report provides a summary of a European Environment Agency (EEA) Scientific Committee Seminar on Environment, Human Health and Well-Being, held at the EEA in Copenhagen, Denmark on February 12th 2014. The objectives of the seminar were to clarify the environment, health and well-being (EHWB) nexus as a focus for integrated EU policy making, and considered the knowledge required to inform EHWB policies. Seminar participants considered how the framework of EU research programmes and instruments might serve to accelerate the generation of relevant knowledge through targeted EHWB research and monitoring across Europe.

Human health and well-being are influenced by environmental conditions both positively and negatively, with significant economic and social consequences. These complex linkages demand a broad interdisciplinary approach to developing research strategies that can steer science towards generating knowledge, in order to answer both current and future questions. Research can deliver two types of knowledge: niche research responding to public concern on an EHWB issue and informing immediate action; or broad, systemic research identifying emerging issues and informing agenda-setting. Research on emerging issues is required to inform an open debate on assessing risks to human health and well-being and address uncertainties.

Science needs to shift from addressing single issues in isolation to researching systemic relationships in inter-disciplinary teams. Valuable approaches towards linking up different kinds of monitoring data that were considered at the seminar include mapping human health data against environmental data, tracking individual exposures over a lifespan and the use of biomonitoring data to tease out geographical and temporal variations in exposure to chemicals.

In order to capture systemic EHWB inter-linkages, assessments need to address multi-causality, cover long timescales and wide spatial scales and capture multiple endpoints. The positive environmental health aspects of the EHWB nexus must also be registered, as well as the impacts of socio-economic factors, uncertainties and spatial aspects. Inevitably, such assessments will throw up conflicts and trade-offs that set a requirement for cross-sectoral cooperation and public participation in in policy making.

Communicating key messages to both policy makers and the public in targeted and digestible outputs was identified as critical to securing impacts from assessments. EHWB linkages can provide powerful arguments that capture the public imagination in support of ambitious policy actions. Communication and collaboration both across policy domains and amongst different stakeholders is critical to ensuring that knowledge generation matches policy needs, and that policy makers pick up and make use of research outputs.

Forward-looking assessments that consider the evolution of the healthcare system in relationship with environmental and socio-economic factors can sketch out possible futures and so galvanise public support for action. The current trend in health care towards personalised healthcare runs parallel to the trend in EHWB towards assessing lifelong individual exposure to multiple factors and can provide opportunities for inter-disciplinary research.

Horizon 2020 can promote a paradigm shift in research funding, using Societal Challenges to frame the agenda for inter-disciplinary research on systemic EHWB issues. Proposals for both niche and systemic EHWB research are welcome under Horizon 2020, which aims at producing excellent science, generating sustainable solutions to address Societal Challenges and achieving industrial excellence. Solutions may include innovations in a range of systems, including technological innovation, as well as innovation in social, institutional, behavioural and spatial systems.

The multiple systemic links between natural resource use, environmental quality and health and well-being demand a shift away from silo approaches to pollution control towards policies that recognise and respond to interlinkages between our socio-technological system and our environment. Key EU policies use the EHWB lens to frame strategic policy objectives for up to 2020, including the Europe 2020 strategy, the 7th Environment Action Programme (7EAP) and the Roadmap to a Resource-Efficient Europe. In particular, achieving the 7EAP objective of living well within the limits of our planet requires a transition in our relationship with our environment. EEA assessments should highlight the multiple factors driving environmental pressures that impact on health and well-being, and identify the transitions required to reduce these pressures.

Integrating the EHWB perspective in the long-term policy agenda will require effective collaboration across the Commission, the EU Agencies and with other stakeholders involve in knowledge generation. Research centres, agencies and policy makers should view their work through a common lens and ensure that the EHWB thread runs from the early stages of monitoring, through systemic assessments and is woven into policy making across all relevant domains.

Human health and well−being are intimately linked to environmental quality. This has been recognised for decades amongst policymakers in Europe, and most recently appears as a cornerstone in the European Union's 7th Environment Action Programme.

While environmental policies have delivered substantial progress in improving the state of the environment in Europe, major challenges remain. Widespread exposure to multiple pollutants and concerns about long-term damage to human health demand more integrated and precautionary approaches. There is a need to recognise the dynamic relationships between natural resource use, environmental quality and health and well-being, and to move away from compartmentalised hazard-based approaches towards an integrated (ecosystem) perspective when developing relevant policies.

Introduction

On February 12th 2014, a European Environment Agency (EEA) Scientific Committee Seminar on Environment, Human Health and Well-Being was held at the EEA in Copenhagen, Denmark. Participants at the seminar considered the knowledge base for environment, health and well-being (EHWB) issues, from the perspectives of undertaking research and monitoring, conducting assessments and making policies.

The understanding of EHWB challenges has deepened in recent times, supported by monitoring, research and assessments, and leading to an increased complexity in problem definition, analysis and policy responses. Of particular relevance are the four environment principles enshrined in the European Union (EU) Treaty, namely the principles of precaution, prevention, polluter-pays and rectification of damage at source. These principles are central to maintaining, improving and managing risks to health and well-being, and should serve to inform research and assessments undertaken under the framework of EU research programmes, such as Horizon 2020, and other EU or Member State research or assessment activities.

Most recent European assessments ([1]) demonstrate multiple systemic links between environment, health and well-being. As a consequence, there is a need to shift from the prevailing pollution-focused agenda to policies that address wider socio-economic and well-being issues and that recognise relations with systems of production and consumption, behaviours, water and land-use and urban issues, and that draw on emerging concepts such as resilience and ecological public health.

[1] EEA/JRC, 2013, *Environment and human health*, EEA Report, 5/2013, European Environment Agency and the European Commission's Joint Research Centre, Copenhagen, Denmark; EEA, 2013, *Environmental indicator report 2013 — Natural resources and human well-being in a green economy*, European Environment Agency, Copenhagen, Denmark; EEA, 2013, *Late lessons from early warnings: science, precaution, innovation*, EEA Report, 1/2013, European Environment Agency, Copenhagen, Denmark; WHO, 2012, *The European health report 2012: charting the way to well-being*, World Health Organization Regional Office for Europe, Copenhagen, Denmark.

Health and well-being aspects are linked to all environmental issues and have significant economic and social consequences. Links can be seen in two ways: adverse pollution pressures on human and ecosystem health and hence well-being; and the benefits to health and well-being of maintaining or restoring natural capital and the flow of ecosystem services that constitute our life-support system ([2]). Both types are relevant to achieving a transition to a more sustainable society in 2050.

The Europe 2020 strategy ([3]), the 7th Environment Action Programme (7EAP) ([4]) and the Roadmap to a Resource-Efficient Europe ([5]) are the EU policy documents that set strategic objectives for the period up until 2020 and longer-term visions up until 2050. The Rio 2012 outcome, "The future we want" ([6]), is also relevant here given its focus on an inclusive Green Economy that combines efficiency, resilience and well-being objectives in a vision for 2050 and plans concrete actions for the next 10 years around systems of consumption and production.

These policies highlight the value of using the EHWB lens to guide integrated, coherent, and effective policy and research responses. As set out in the EEA's Multi Annual Work Programme for the period 2014-2018 ([7]), the EEA will produce a first EHWB assessment by 2018 as well as a third volume of Late Lessons from Early Warnings that will look at long-term (2050) transitional approaches to the broader EU environment agenda. Both assessments and policies would benefit from research to close key knowledge gaps.

Effective policy strategies require relevant health and well-being monitoring systems and indicators that link spatial patterns and trends to socio-economic, technological and environmental changes. This is key to supporting (i) scientific research and early investigation to identify human health changes correlated with positive and negative changes in major environmental stressors; (ii) the identification of major drivers of health inequalities across Europe; and (iii) precautionary, preventative and rectification actions by authorities and follow-up assessment of actions.

Addressing the gaps in monitoring, data, indicators, assessments and knowledge in this respect would be a priority for research, as well as being of key importance for the European Earth Observation Programme, Copernicus, and for knowledge networks such as the European Environment Information and Observation Network (Eionet). However, current research efforts are often targeted towards developing a deeper understanding of already-known phenomena, rather

[2] World Resources Institute, 2005, *Millennium Ecosystem Assessment, 2005, Ecosystems and Human Well-being: Synthesis*, Island Press, Washington, DC.
[3] EC, 2011, 'Europe 2020 strategy flagship initiative for a resource-efficient Europe', (http://ec.europa.eu/resource-efficient-europe/) accessed March 4, 2014.
[4] EU, 2013, Decision No 1386/2013/EU of the European Parliament and of the Council of 20 November 2013 on a General Union Environment Action Programme to 2020 'Living well, within the limits of our planet', COD 2012/0337, see the 2050 vision in the Annex: "In 2050, we live well, within the planet's ecological limits. Our prosperity and healthy environment stem from an innovative, circular economy where nothing is wasted and where natural resources are managed sustainably, and biodiversity is protected, valued and restored in ways that enhance our society's resilience. Our low-carbon growth has long been decoupled from resource use, setting the pace for a safe and sustainable global society."
[5] EC, 2011, Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, 'Roadmap to a Resource Efficient Europe' COM(2011) 571 final.
[6] United Nations General Assembly, 2012, 'Resolution adopted by the General Assembly [without reference to a Main Committee (A/66/L.56)] 66/288, The future we want', Rio+20 Outcome Document, (http://www.unece.org/fileadmin/DAM/env/documents/2012/A_RES_66_288_TheFutureWeWant_e.pdf).
[7] EEA, 2013, *Multi-Annual Work Programme: Assessing Systemic Challenges – Environment, human health and well-being*, European Environment Agency, Copenhagen, Denmark.

than addressing systemic, emerging issues ([8]). In addition, environment, health and well-being monitoring, research, assessments and policy-making are still most often dealt with in silos, rather than through integrated approaches.

Objectives of the Seminar

The overall objective of the seminar was to explore the knowledge base for environment, health and well-being issues, from the triple perspectives of (i) policy, (ii) assessments and (iii) research and monitoring. To this end, seminar participants aimed to:

1. Clarify the EHWB objectives of the EEA and their relevance to the implementation and visions of relevant EU policies, for both the 2014-2020 and the 2020-2050 perspectives;

2. Consider the knowledge requirements to support assessments on EHWB by EEA ([9]) and partner institutions (e.g. Directorate-General for Research and innovation (DG RTD), Joint Research Centre (JRC), World health Organization (WHO)) and how to accelerate the development of this knowledge over the period 2014-2020;

3. Address the multiple interfaces between policy and science in the EHWB area and how knowledge can be further aligned to policy needs through Horizon 2020 strategic programming and activities and FP7 follow-up activities; and

4. Identify options over the period 2014-2020 and beyond for using EU instrument (e.g. Horizon 2020, Life+, SEIS, Inspire, Copernicus) to design and implement efficient and harmonized EHWB monitoring systems across Europe.

Structure of the Seminar

The seminar was organised around three sessions, entitled:

- Towards strategic research programming on EHWB in Horizon 2020;
- Clarifying the environment, health and well-being nexus as a key focus to achieve the objectives of relevant EU EHWB policies; and
- Bridging the policy-science-assessments gaps for EHWB.

[8] Grandjean, P., 2013, 'Science for precautionary decision-making', in: EEA, (ed.) *Late lessons from early warnings: science, precaution, innovation*, EEA Report, 1/2013, European Environment Agency, Copenhagen, Denmark.
[9] Strategic Area 2.2 of EEA, 2013, *Multi-Annual Work Programme: Assessing Systemic Challenges – Environment, human health and well-being*, European Environment Agency, Copenhagen, Denmark.

Under each session, a number of experts provided presentations. These were then followed by discussions, mediated by a chair.

This meeting report provides a summary of the presentations and discussions structured according to the programme of the workshop, including: opening remarks; the three sessions; and closing remarks. Some overall reflections are then provided on how the seminar addressed the original objectives and on future perspectives on the EHWB knowledge base.

Opening Remarks

In opening the seminar, **Hans Bruyninckx, EEA Executive Director**, noted that society is facing complex issues characterised by multiple interactions that cannot be captured in simple causal relationships. He expressed the aim that the seminar would enhance understanding of the complex systemic linkages to allow for a better framing of questions on EHWB, leading to better policy interventions and better results for society.

Sybille van den Hove, Chair of the EEA Scientific Committee, stressed the importance of looking at the multiple directions of linkages: e.g. negative effects of environmental pressures on health and well-being; positive effects of a healthy environment on health and well-being; positive impacts of well-being on health; situations where a healthy environment is a cure; potential negative impacts of some pharmaceuticals on environment and ultimately on health; etc. She called on participants to reflect on innovation, not just technological innovation, but also innovations in the way we think and understand (epistemological and methodological innovations), and in the way we act (social, behavioural, organisational, institutional and political innovations).

Session 1: Clarifying the environment, health and well-being nexus as a key focus in achieving the objectives of relevant EU EHWB policies

Chaired by **Owen McIntyre, EEA Scientific Committee**, discussions focused on key objective 3 of the 7EAP, *To safeguard the Union's citizens from environment-related pressures and risks to health and well-being*, and on enabling objective 5 of the 7EAP, namely *To improve the knowledge and evidence base for Union environment policy*, including in particular the objective of improving *the understanding of, and the ability to evaluate and manage, emerging environmental and climate risks.*

The session was broken down into three sub-sections, focusing on (i) the strategic policy landscape; (ii) the assessment landscape; and (iii) the science landscape.

The Strategic Policy landscape

Ladislav Miko, Directorate General for Health and Consumers (DG SANCO), provided a video address, in which he explained how DG SANCO tackles the EHWB nexus. Increasing attention is given to the systemic character of the evolving health challenges that society is facing. The linkages between patterns of resource use and human health and well-being are particularly apparent in the case of the food system, where growing food demand, resource limitations and the impacts of climate change generate a combined pressure on food security. From a resource efficiency perspective, reducing food waste is of particular relevance. The complex systemic linkages, for example between the food and climate systems, call for a broad interdisciplinary approach to research planning and policy responses. A challenge for research strategies is to steer science to focus on the right questions.

Alan Seatter, Directorate General Environment (DG ENV), noted that in addressing environmental threats to health thus far, we have successfully taken an approach that controls individual sources of pollution. This approach, however, fails to respond to the systemic nature of environmental pressures on health. In particular, health research should not begin and end at the hospital door, but rather should encompass well-being. It is challenging for public institutions to deal with well-being, due to the intangible elements associated with well-being. With regard to dealing with emerging risks, we have not yet learnt the lessons from past. There is a need for new tools and methods for assessing and managing risk and uncertainty and for improved dialogue across EU institutions. A more sophisticated and inclusive approach towards risk management is called for, whereby the public participates in the diagnosis of risk. If we are to deliver on the 7EAP, we need both a research agenda that can inform actions on today's questions on environment, health and well-being, as well as a research agenda that identifies and answers tomorrow's questions. Achieving this will require improvements in the political and institutional relationships that surround research.

In the **discussion**, the following points were made:

- Health and well-being are potentially the more potent arguments for environmental policies. Aspects of well-being resonate well with the public and convince people to act on environmental issues. The crucial role of the EEA in capturing these aspects in horizontal assessments and communicating them to decision-makers was highlighted. Copernicus was cited as a potential tool for improving public involvement in issues.
- An individual's psychological condition is an important aspect of well-being in addition to direct health effects. Fear of illness following exposure to asbestos is a good example.
- The 7EAP captures well-being, establishes relevant priorities and plans actions to make a difference at the EHWB nexus. There is a need to bring teams of people across the Commission, EU agencies and the JRC together to work collaboratively in a structured way to map out relevant research needs.
- Relevant institutions should be specifically tasked to undertake broad foresight studies using new methods of horizon scanning for the identification of emerging issues.
- There is a need to enrich assessments with information on the degree of ignorance in order to allow politicians to take decisions fully conscious of uncertainties. The question was raised as to who should decide on pathways through uncertainty, scientists or politicians.
- Current Environmental Impact Assessment methods should be expanded to systematically capture health and well-being aspects and to connect to a wider range of decision makers.
- Noting that addressing human well-being from an ecosystems perspective is now accepted in theory, practical steps to achieve this in policy terms are called for.

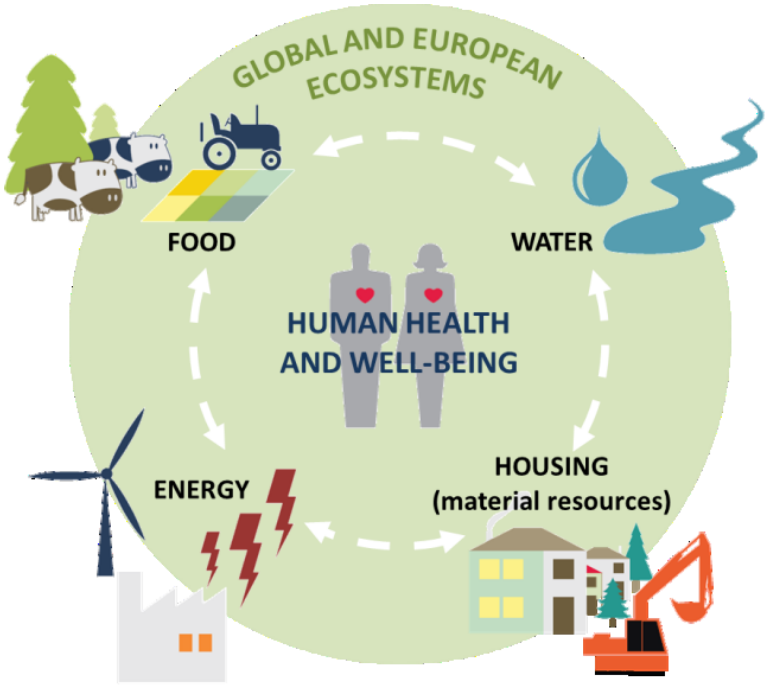
The Assessment landscape

Ybele Hoogeveen (EEA) considered how the evolving environment and health domain is addressed in recent EEA assessments. Linking environment and health considerations to the resource efficiency agenda can help to mainstream the EHWB agenda. The 2013 EEA report on environment and health ([10]) argued that in order to reduce multiple exposures and improve health and well-being outcomes of natural resource use, there is a need to move away from compartmentalised hazard-based approaches towards an integrated (ecosystem) approach. Assessments should also capture the positive environmental health aspects of the EHWB nexus, and address inequalities, uncertainties and spatial aspects. The EEA's 2013 *Environmental Indicator Report* ([11]) focussed on food, water, energy and housing to explore the strong linkages between patterns of resource use, associated

[10] EEA/JRC, 2013, *Environment and human health*, EEA Report, 5/2013, European Environment Agency and the European Commission's Joint Research Centre, Copenhagen, Denmark.
[11] EEA, 2013, *Environmental indicator report 2013 — Natural resources and human well-being in a green economy*, European Environment Agency, Copenhagen, Denmark.

environmental pressures and direct and indirect impacts on human well-being (see figure 1). Policy responses need to consider the trade-offs, with spatial planning being key to integrating all aspects of EHWB into policy making.

Figure 1: Health, well-being and natural resource use

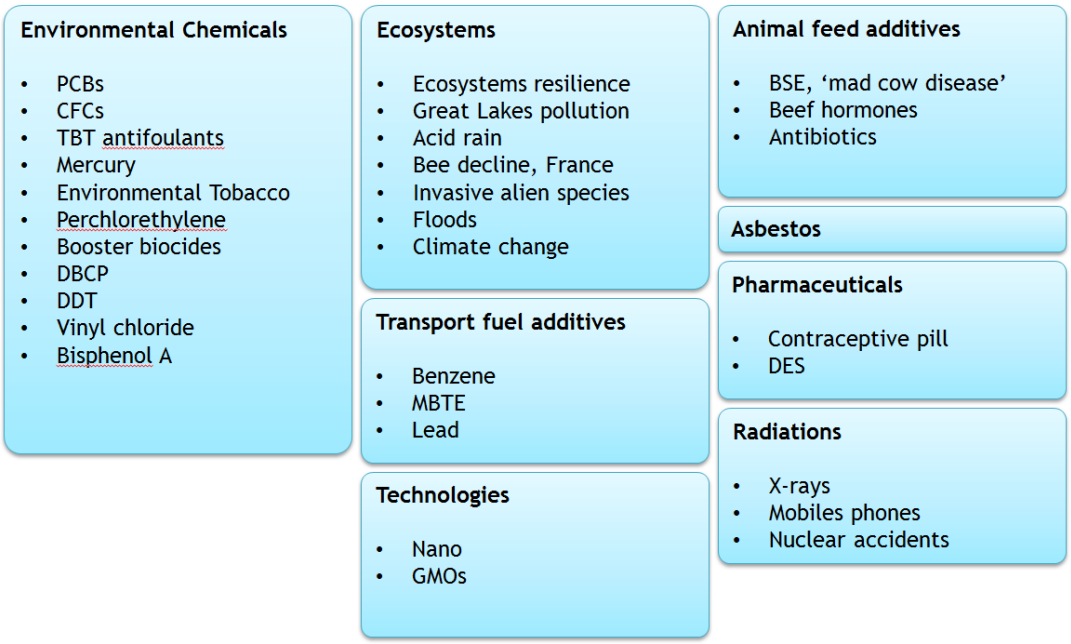


Source: Redrawn from EEA, 2013, *Environmental indicator report 2013 — Natural resources and human well-being in a green economy*, European Environment Agency, Copenhagen, Denmark.

Jock Martin (EEA) presented insights from the EEA's 2013 ([12]) and 2001 ([13]) publications on **'**Late lessons from early warnings'. Thirty-four cases of early warnings of threats to well-being and the environment (see figure 2) demonstrate that estimates of the costs of action are often exaggerated; costs fall on taxpayers rather than the source of harm; the extent of harm expands over time for humans and ecosystems; and that early precautionary action stimulates innovations that bring benefits for people's health and well-being. Environmental challenges have evolved from local problems with relatively simple cause-effect chains, to global systemic issues with multiple interconnected sources. Research therefore needs to balance precision and relevance, embrace multi-causality, cover longer timescales and capture multiple endpoints. This increased complexity calls for integrated policies that benefit from stakeholder involvement and a transparent analysis of the value conflicts and trade-offs involved. Effective risk reduction strategies focus on upstream innovations rather than downstream pollution abatement.

[12] EEA, 2013, *Late lessons from early warnings: science, precaution, innovation*, EEA Report, 1/2013, European Environment Agency, Copenhagen, Denmark.
[13] EEA, 2001, *Late lessons from early warnings: the precautionary principle 1896-2000*, Environmental issue report No 22/2001, European Environment Agency, Copenhagen, Denmark.

Figure 2: The 34 cases of early warnings over 100+ years analysed in the EEA's two Late Lessons publications

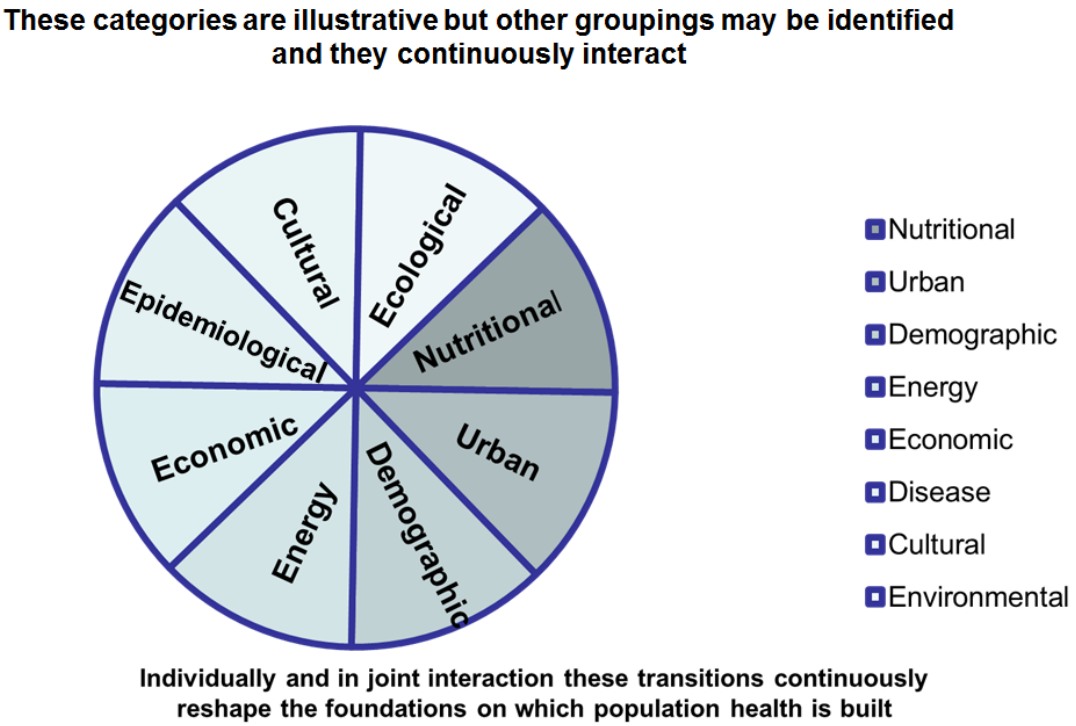


Source: Taken from the presentation provided by Mr Martin at the seminar

Brigit Staatsen, Dutch National Institute for Public Health and the Environment, presented the work carried out by a consortium of EIONET partners under an Article 5 contract for the EEA (FRESH ([14])). FRESH analyses changes and transitions in fundamental drivers of human health and well-being (figure 3), using foresight reasoning and an analytical framework (DPSEEA) as originally introduced by the World Health Organization (WHO) ([15]). The modified DPSEEA model (mDPSEEA) ([16]), as used in FRESH, expands the framework to include the influence of social and economic factors. Capturing both negative and positive environmental health impacts, FRESH has developed a narrative around urbanisation and ageing. By 2050, 80% of the EU population is expected to live in urban areas and 30% of that population will be over 65 years old. This has implications for housing, transport and physical planning. There is a need for strong cross-sectoral cooperation and public participation when reflecting on the potential conflicts and trade-offs inherent in the multi-faceted domain of urban policy.

[14] Foresighted Reasoning on Environmental Stressors and Health
[15] WHO, 2004, *Development of environment and health indicators for European Union countries: results of a pilot study*, WHO European Centre for Environment and Health (ECEH), Bonn, Germany.
[16] Morris, G., Beck, S. A., Hanlon, P. and Robertson, R., 2006, 'Getting strategic about the environment and health', *Public Health* 120 (10), pp. 889–903.

Figure 3: Transition categories that influence public health



Source: Presentation provided by Ms Staatsen at the seminar

In the **discussion**, the following points were made:

- In view of the challenges involved in communicating complex issues to the public, there is a need for proactive engagement with stakeholders in the identification of policy needs.
- There remains considerable inertia in scientific research, where the focus is often on compartmentalised single issues. There are also path dependencies in research that steer research towards investigating familiar, known problems. The current failure to mainstream a systems approach in research does not inspire the necessary innovations in research governance. To shift the focus of scientific research from old, single issue problems to new, systemic challenges, changes in the education system are needed. At the same time, participants recognised the value of previous research in providing an evidence base for decision-making.
- Although still considered rather conventional by some participants, who identified a real risk of falling back into the silo trap, Horizon 2020 has the potential to promote a paradigm shift in research funding, by setting the agenda for inter-disciplinary systemic research addressing Societal Challenges. This requires vision, ambition and daring on the part of those responsible for managing the Programme. There is room in Horizon 2020 to look at new ways of doing research and this opportunity should not be lost. To this aim, both the EC and the scientific community will need to change their working practices and collaborate across silos. It is also

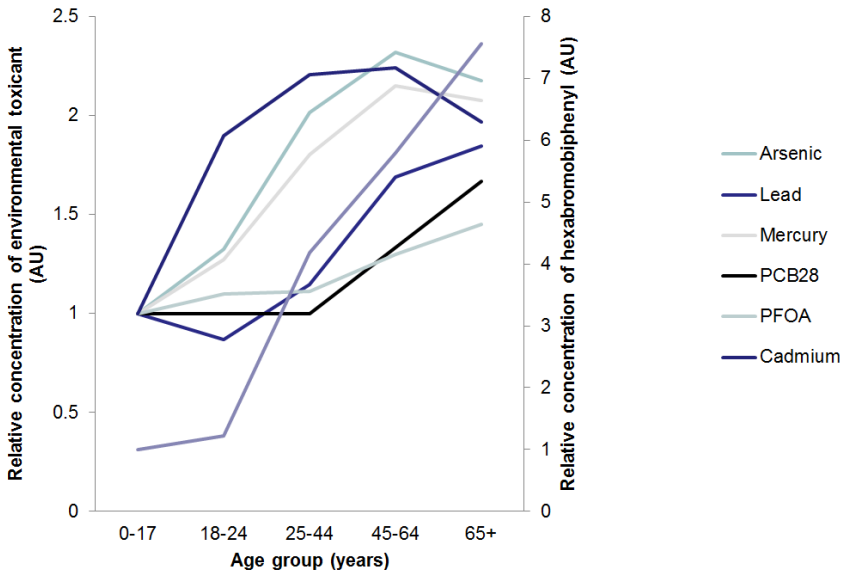
important that EHWB aspects are taken seriously in applications for European Research Council funding.

- The importance of developing and enabling effective science-policy interfaces on EHWB issues was also stressed, an example being the Harvard Medical School training programme for policy-makers.
- Spatial planning is ultimately very important for human health and well-being, influencing urban patterns of transport, land use and energy consumption.
- There exists a fundamental problem in the way we understand costs and value in standard economic thought, which often comes down to an assumption of free disposal. Describing environmental impacts as "externalities" suggests that ontologically we see the environment as external to human society, whereas we are *de facto* part of a social-ecological system.

The Science Landscape

Michael Depledge, European Centre for Environment and Human Health (ECEHH), University of Exeter, stressed the intimate interconnection between human health and environment. The ECEHH's ethos aims to make people aware that we need a new culture of health and environmental sustainability. The ECEHH aims to engage with policy makers and the public, and channel evidence drawn from scientific research to these stakeholders in targeted and digestible outputs. As for exposure to chemicals in the environment, ECEHH research has shown that the body burden of environmental toxicants increases with age (see figure 4), with socio-environmental factors playing an important role. As well as focussing on how environmental stressors impact on health, ECEHH also studies health gains from the environment through qualitative research in disciplines such as environmental psychology. How environmental factors can influence well-being is illustrated by the fact that the percentage of the population considered to be in good health is positively correlated with increased proximity to the sea.

Figure 4: Graphs representing the variation in the serum concentration of a range of environmental toxicants with age. The data were collected from the US National Health and Nutrition Examination Survey (NHANES). The serum concentrations were noted to increase significantly with age for all chemicals ($p < 0.001$, ANOVA).

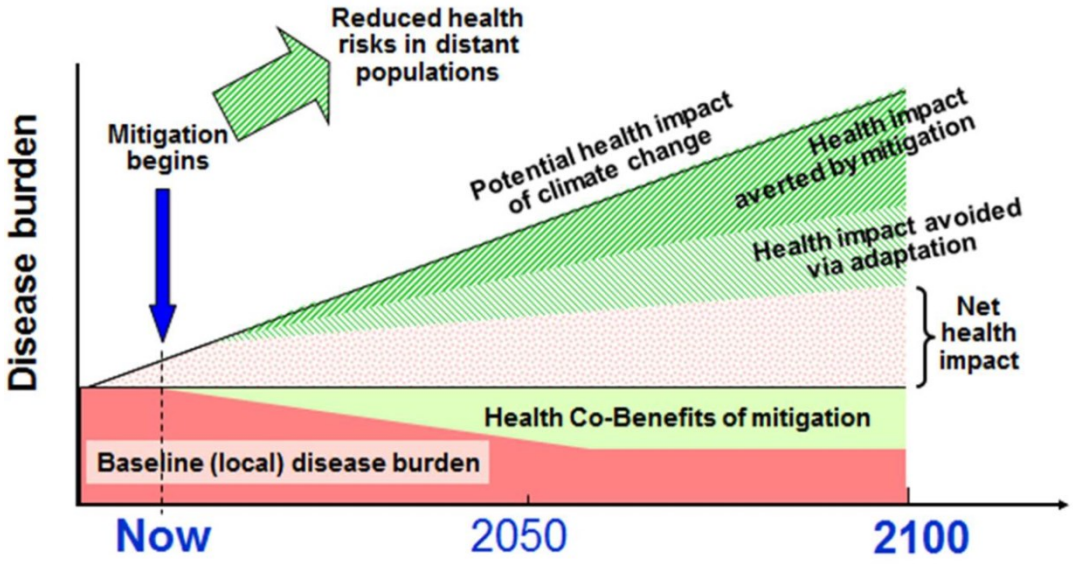


Notes: PCB28 is otherwise known as2,4,4'-Trichlorobiphenyland PFOA is otherwise known as perfluorooctanoic acid.

Source: Presentation provided by Mr Depledge at the seminar, adapted from Depledge, M.H., Tyrrell, J., Fleming, L.E., Holgate, S.T., 2013, 'Are marine environmental pollutants influencing global patterns of human disease?', *Marine Environmental Research*, 83, pp. 93-95.

Elisabet Lindgren, Institute of Environmental Medicine, Karolinska Institute, provided an overview of the links between climate change and health. Changes in the burden of disease are an emerging health threat, mediated through local conditions, vulnerabilities, resilience and adaptive capacity. Climate change interacts with other drivers of health through multiple systemic linkages, and inter-disciplinary research, including social sciences, is required to assess its impacts. This is illustrated by the urban heat island effect, whereby additional factors such as air pollution, ageing populations and building type exacerbate the health impacts of unusually high temperatures. Indirect health effects from climate change may result from environmental factors, including changes in land use, biodiversity loss and invasive species, reductions in water quality and quantity and changes in the propensity of plant and animal diseases. Socio-economic factors can also play a role, such as the impact of travel on the spread of infection disease (combined with the extended range of some vector organisms due to climate change) and the impact of man-made infrastructures on the extent of flooding. As shown in figure 5 below, climate adaptations and climate mitigations frequently offer health co-benefits that should be considered in risk management and policy developments.

Figure 5: Health co-benefits of climate change mitigation and adaptation



Source: McMichael, A. J. and Lindgren, E., 2011, 'Climate change: present and future risks to health, and necessary responses', *Journal of Internal Medicine*, 270 (5), pp. 401–413.

Bert Brunekreef, Institute for Risk Assessment Sciences, University of Utrecht, reported on a project entitled *Research Findings in support of the EU Air Quality Review* ([17]). In the case of particulate matter it has not been possible to identify one or two chemical components that are clearly more harmful to health than others. Rather, established health effects are likely caused by several characteristics and components of the complex mixture of PM in ambient air. Research has found that any reduction in overall PM mass yields health benefits. The EU air quality standard for $PM_{2.5}$ lies above the threshold established for human health protection in the WHO Air Quality Guidelines ([18]) (see figure 6). Adverse health effects from $PM_{2.5}$ exposure occur at levels well below current EU limit values. ESCAPE ([19]), a Seventh Framework Programme study, investigated the links between ambient air pollution and health effects across the EU and identified a range of negative health impacts that occur along the human lifespan. For example, $PM_{2.5}$ exposure during pregnancy is associated with term low birth weight, even at values lower than the EU annual $PM_{2.5}$ limit of 25 $\mu g/m^3$ ([20]). This calls for lowering the EU $PM_{2.5}$ limit values for ambient air. In moving forward, policy makers could depart from the perspective of healthy urban living and integrate health concerns in policy decisions on urban transport and on the environment.

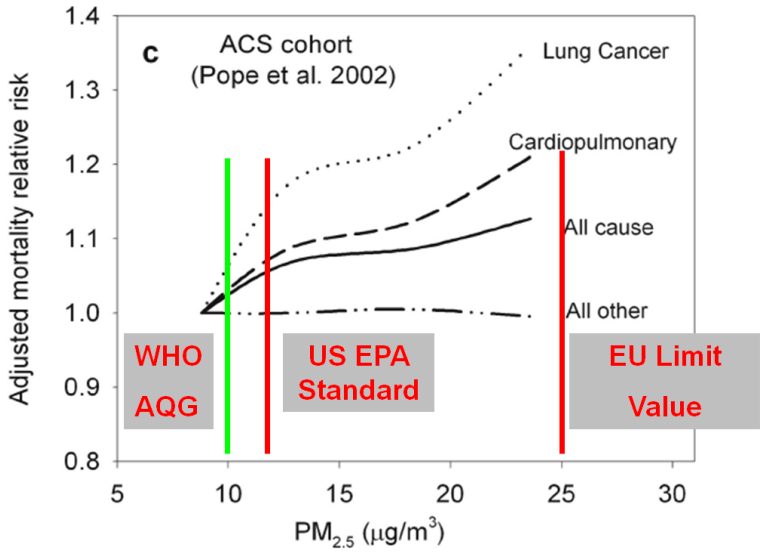
[17] Fowler, D., Brunekreef, B., Fuzzi, S., Monks, P. S., Sutton, M. A., Brasseur, G. P., Friedrich, R., Passante, L. G. and Jimenez Mingo, J. M., 2013, *Research findings in support of the EU Air Quality Review*, European Commission, Directorate-General for Research and Innovation, Brussels, Belgium.

[18] WHO, 2006, *WHO Air quality guidelines for particulate matter, ozone, nitrogen dioxide and sulfur dioxide, Global update 2005*, World Health Organization, Geneva, Switzerland.

[19] European Study of Cohorts for Air Pollution Effects

[20] Pedersen, M. *et al.*, 2013, 'Ambient air pollution and low birth weight: a European cohort study (ESCAPE)', *The Lancet Respiratory Medicine,* 1 (9), pp. 695-704.

Figure 6: Air Quality Standards for annual mean $PM_{2.5}$ concentration



Source: Presentation provided by Mr Brunekreef at the seminar

Michelle Epstein, Medical University of Vienna, identified links between the prevalence of allergies and pollen concentrations in ambient air. One in five people has allergies; one in seven has allergic rhinitis; and one in eleven has asthma. One quarter of atopic workers take time off work due to the symptoms of allergic rhinitis, with the average productivity loss per employee per year estimated at $593 (see figure 7). The invasive plant species ragweed (*Ambrosia artemisiifolia*) is one of the most aggressive of the pollens that induce allergies, allergic rhinitis and in some cases asthma. High pollen concentrations can result in high sensitization to pollen amongst children, an effect that is exacerbated by low air quality. Relative increases in Ambrosia pollen concentrations are predicted for the period 2010 to 2030. There is a need for observational pollen data to feed into future scenarios and risk assessment in order to measure the costs of future health and economic impacts (e.g. health care costs and loss of productivity) against the costs of intervention in the form of weed eradication.

Figure 7: Mean productivity loss per year per employee due to allergic rhinitis against other causes of lost productivity

Source: Presentation provided by Ms Epstein at the seminar

In the **discussion**, the following points were made:

- In real life, things do interact and it is the combined impact that matters. Therefore, focussing on one aspect only (for example monitoring exposure to one chemical) is not sufficient. Systemic research is needed, capturing multiple drivers, and building on different plausible scenarios.
- Systemic research can effectively draw together the results of multiple studies in order to examine patterns and thematic linkages across spatial scales. Such inter-disciplinary research requires capable leaders who can make the necessary connections and integrate perspectives.
- Privacy issues pose challenges to large scale studies on health.
- In view of conflicting interests; scientific rigour is key.
- The EHWB knowledge base can build on individual case studies and narrow-focus "niche" research, or on broad research of wider relevance. Both are important. Niche research can respond to specific public concerns regarding health and take an intermediate step towards solving the problem, while broader systemic research helps to capture emerging issues and set the agenda. The two last presentations were examples of niche research where we have the information to act. The question is whether or not policy actions are sufficient.
- Horizon 2020 provides a framework for both niche and broad research. As not all research will address a systemic agenda, overarching narratives are required to provide guidance and context.
- New, creative and meaningful ways of interfacing science with policy and, more broadly, society are needed.

Key ideas

- Health and well-being are of direct concern to the European citizen and yet policy makers fail to inspire engagement in critical environmental issues. Storytelling is under-utilised. We need to tell the right stories to make the personal consequences of environmental and lifestyle changes tangible to the public.
- The political and personal choices we make today have implications for future quality of life. It is a major problem that tomorrow's decision makers are taught the knowledge of yesterday. We need forward-looking assessments, capturing plausible futures and inspiring people to act.
- We need to capture forward looking aspects related to the health care system. How will the health care system evolve and address EHWB challenges?
- Better policy outcomes on EHWB issues require spatial integration, but the scale at which we do that is often implicit or arbitrary. A spatial development perspective at European level is largely lacking.

Session 2: Towards strategic research programming on environment, health and well-being in Horizon 2020

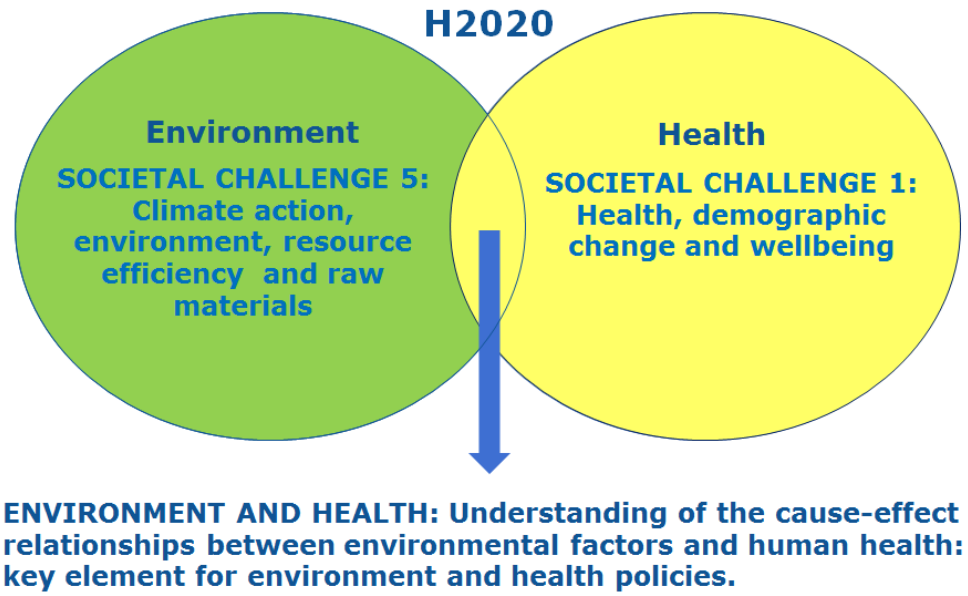
This session addressed the need for integrative, interdisciplinary, cross-cutting systems science for EHWB issues and explored this need in the context of Horizon 2020. Chaired by Richard Johnson, EEA Scientific Committee, the session was divided into sub-sessions on the EU research landscape and key dimensions of environment and health monitoring and research.

The EU Research Landscape

Kurt Vandenberghe (DG RTD) and **Arnd Hoeveler (DG RTD)** provided a joint presentation on the Horizon 2020 research and innovation funding programme. With its challenge-driven approach and strong focus on end-users, Horizon 2020 represents a break from the past, making it more responsive to societal needs than former EU framework programmes for research. It has three priorities: producing excellent science, achieving industrial leadership and tackling seven Societal Challenges. Particularly in view of the current economic crisis, contributions to economic growth and creating jobs are considered essential. Given that 70% of innovation in our society is estimated to be of a non-technical nature and located in finance, governance, social and business practices, Horizon 2020 will mobilize a wide range of stakeholders.

Research under H2020 should go beyond describing the problems, to providing sustainable solutions for Societal Challenges. Most relevant to EHWB are: Societal Challenge 1 on health, demographic change and well-being; Societal Challenge 2 on food security, sustainable agriculture and forestry, marine and maritime and inland water research and the bio-economy; and Societal Challenge 5 on climate action, environment, resource efficiency and raw materials. These challenges are interrelated as depicted in figure 10 below. Regarding health research, there will be increasing attention to personalised health care and prevention. This places the patient in focus by including individual genetic and environmental determinants, and serves to stimulate better communication between experts in the environment and health domains.

Figure 10: Environmental and health under Horizon 2020



Source: Presentation provided by Mr Vandenberghe at the seminar

In the **discussion**, the following points were made:

- International collaboration under Horizon 2020 is important, with the objective of having researchers working at the global scale with a long-term vision.
- Horizon 2020 lacks a specific programme on environment, health and well-being. Moreover, the current approach should focus not only on conditions of ill-health but also on how to avoid sickness. Here there is a powerful link with environment and well-being. The topics, however, are broadly formulated regarding the expected outcome, and research proposals with environmental elements are expected under Societal Challenge 1 on Health, Demographic Change and Well-Being.
- Horizon 2020 has the flexibility to support work across the Societal Challenges and avoid silos. This is essential to achieving the objectives of the 7EAP.

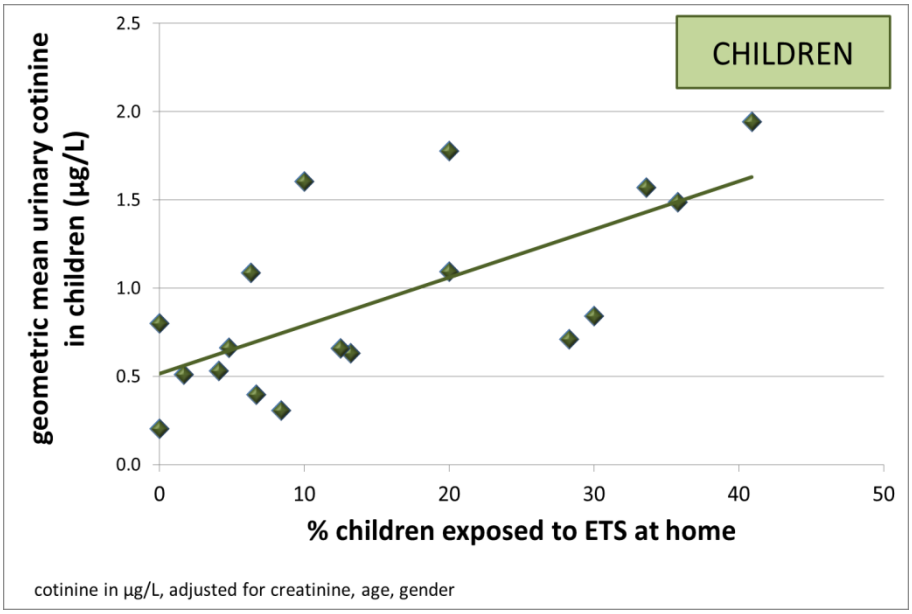
Key Dimensions of Environment and Health Monitoring and Research

Greet Schoeters, EEA Scientific Committee, presented data about exposure to chemicals, obtained through human bio-monitoring research. A 2011 study ([21]) attributed 8.3% of global deaths in the year 2004 to chemical exposure. However, many substances known to be toxic, such as mercury,

[21] Prüss-Ustün, A., Vickers, C., Haefliger, P. and Bertollini, R., 2011, 'Knowns and unknowns on burden of disease due to chemicals: a systematic review', *Environmental Health,* 10 (1), pp. 9.

cadmium and dioxins, had to be excluded from the study because the links between health and chemical exposure are poorly documented. The results of the COPHES ([22]) and DEMOCOPHES ([23]) projects, collected in a harmonised way in 17 countries, show that EU citizens have different chemical body burdens that may relate to individual life style choices (see figure 11 below), as well as to national policies. For example, the concentrations of cotinine in children's urine were found to be negatively correlated with the strength of legislative controls on environmental tobacco smoke, providing evidence of the efficacy of policy measures in reducing exposure. Similar policy successes that emerge from human bio-monitoring data concern reductions in PFC exposure and reduced concentrations in maternal milk, and declines in blood lead concentrations following the elimination of lead from gasoline. Only an EU-wide human biomonitoring program with harmonised procedures for recruiting participants, chemical analysis and data treatment can allow for the robust detection of geographic variations in chemical body burdens and temporal trends. A good example of such an approach is the human biomonitoring programme undertaken by the Centres for Disease Control and Prevention (CDC) in the US under the National Health and Nutrition Examination Survey (NHANES).

Figure 11: Relationship between exposure to ETS and cotinine concentrations in children's urine as recorded under DEMOCOPHES



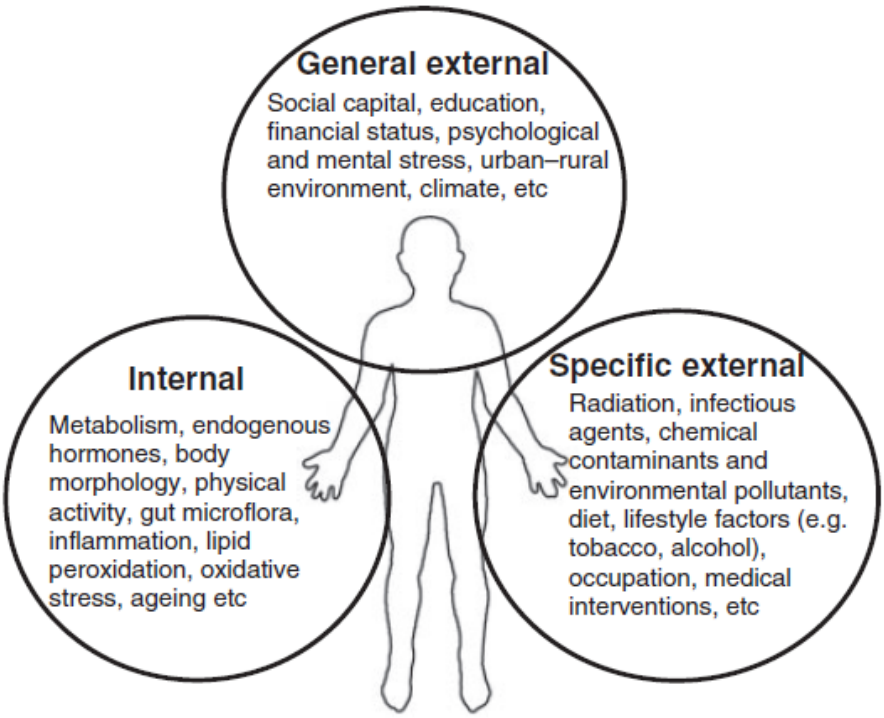
Source: Presentation provided by Ms Schroeters at the seminar

Martine Vrijheid, Centre for Research in Environmental Epidemiology (CREAL), described a framework for undertaking integrated health and environment risk assessment. Environmental factors underlying disease etiology have generally received far less attention than genetic factors.

[22] Consortium to Perform Human Biomonitoring on a European Scale
[23] Demonstration of a Study to Coordinate and Perform Human Biomonitoring on a European Scale

Exposome is a new multi-systemic concept that includes internal, general external and specific external components (see figure 12). It aims to capture all environmental exposures from conception onwards, including those from diet, lifestyle and endogenous sources. For example, the HELIX 'early-life exposome' project combines all the environmental hazards that mothers and their children are exposed to and links them to the health, growth and development of the children. The Exposome concept is not only comprehensive; it is also dynamic as it tracks exposure over an individual's life span. As such, it holds great promise and could help to provide a better understanding of the complex multi-systemic factors that contribute to disease, health and well-being.

Figure 12: Components captured by the Exposome concept

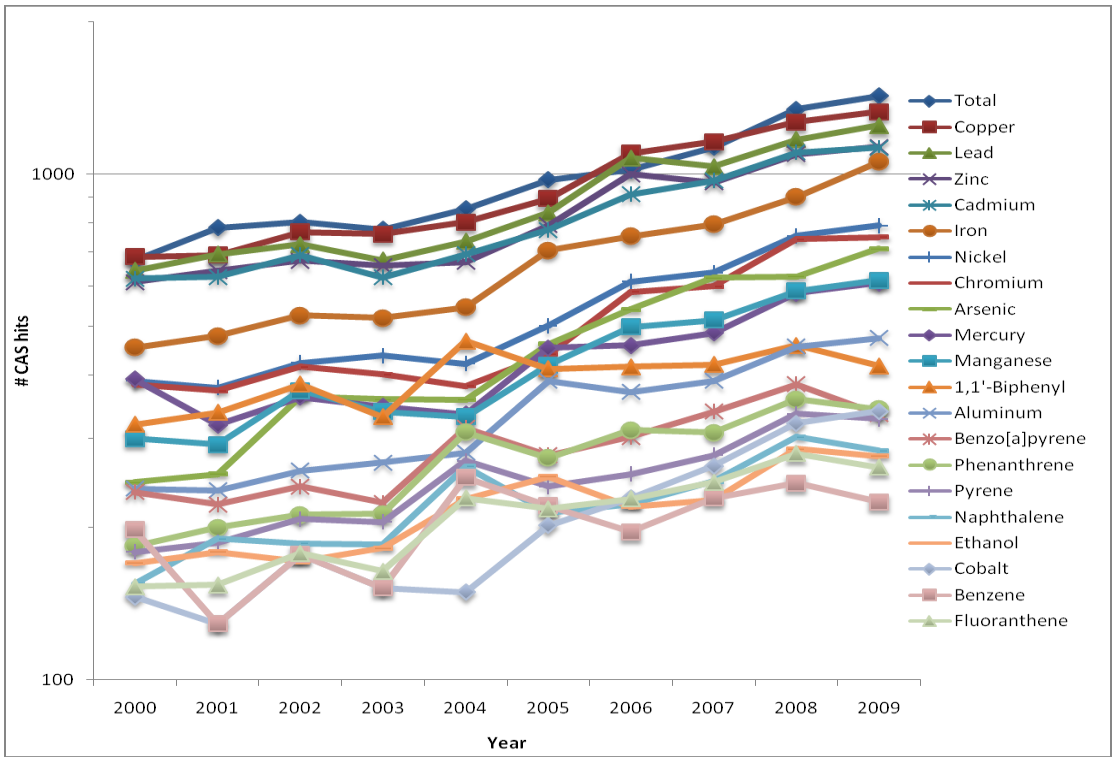


Source: Presentation provided by Ms Vrijheid at the seminar

Philippe Grandjean, EEA Scientific Committee, argued that current research is biased towards studying relatively well-known problems. Many research outputs do not substantially contribute to the advancement of knowledge, but rather serve to replicate existing evidence. Figure 13 below demonstrates how the focus of articles in the scientific literature is biased towards 20 chemicals, the risks of which are well known and documented. More research should focus on emerging issues, a goal that runs counter to current funding, publication and citation practices. There is a need to move away from 'safe science' (or 'minimum risk research'). We should answer the following questions: Are research decisions based on questions relevant to users of research? Are appropriate research designs, methods, and analyses used? Is the regulation and management of research efficient? Is research information fully accessible? Are unbiased and usable research reports being produced?

The overarching question of relevance is: *Are we sufficiently confident that this exposure to a potential hazard leads to doses of a magnitude that can result in adverse effects that are serious enough to initiate transparent and democratic procedures to decide on appropriate intervention?* Policy is still based on the outdated concept that hazards are innocuous until proven otherwise, while in the field of EHWB research, the big issues are not false positives but false negatives. With regard to the framework for research provided by Horizon 2020, it needs to deliver knowledge, not just information. In particular, innovation is required to gain new knowledge about vulnerable life stages, individual susceptibility, delayed or long term effects and complex exposures. A stronger focus is called for on unexploited research opportunities and on environmental health priorities that thus far have been ignored.

Figure 13: A Total numbers of publications on the top-20 toxic substances in environmental science journals during 2000-2009, as compared to the total average number for each journal

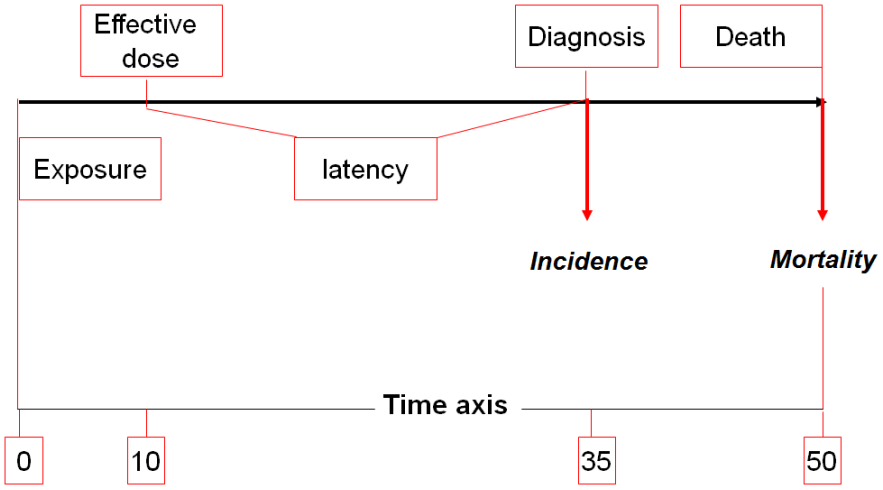


Source: Presentation provided by Mr Gandjean at the seminar, taken from Grandjean, P., Eriksen, M.L., Ellegaard, O. & Wallin, J.A., 2011, 'The Matthew effect in environmental science publication: A bibliometric analysis of chemical substances in journal articles' *Environmental Health*, 10 (1), pp. 1-8.

Pierluigi Cocco, EEA Scientific Committee, spoke on the power of geo-medicine, with reference to an application available in the US, iOS App- Geomedicine at Your Fingertips, which links public health information to an individual's environmental experience in terms of their historical proximity to environmental hazards or exposures. The application matches health data with a wide range of monitoring data and spatial data, including the Toxic Release Inventory (TRI) of the United States Environmental Protection Agency (US EPA) and the Haz-Map of the US National Library of Medicine.

Geomedicine tools can provide insights into how disease is distributed geographically, as well as variations in incidence and correlations with suspected determinants over time and space. Incident data may facilitate hazard identification and be used to redefine priorities and drive preventative policies aimed at reducing harm to human health and the environment. The time periods between exposure, diagnosis and death can be long for some diseases, as shown in figure 14 below. Geo-medicine tools could be used to detect significant health events and allow for early prevention and reduced mortality. In terms of the efficacy of health care services, geo-medicine can be used to assess whether the distribution of health care services matches actual needs over space and time and whether services are effective in preserving health and well being in the general population. Such tools can also allow citizens to check their subjective intuitions and better understand if and where an association can be made between an exposure and a disease. There is scope for the creation of an ICT infrastructure using hospital records and matching incidence data with environmental monitoring data, to be updated as frequently as possible and to be available online at the highest resolution.

Figure 14: Time periods between exposure, diagnosis and death for environmental diseases



Source: Presentation provided by Mr Cocco at the seminar

In the **discussion**, the following points were made:

- Human bio-monitoring data are an important tool in tracking flows of chemicals through society and analysing human exposure. Human bio-monitoring may provide the potential for

demonstrating the effectiveness of the Regulation on Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) ([24]) in the future.

- Given that human bio-monitoring data is regularly collected in the US, it is surprising that efforts to generate comparative data in the EU are limited to the COPHES and DEMOCOPHES projects. The US has established long-term cohort research in which monitoring human exposure to chemicals is combined with information on nutritional biomarkers and health information. In addition, the US has a tradition of public access to datasets. The EU could learn from the US with regard to data accessibility. In Europe, the issue of human exposure to chemicals has been addressed by researchers in the fields of environment and in ecotoxicology.
- With regard to the Horizon 2020 work programme, we need to ensure that the panels of experts evaluating proposals represent a range of different disciplines (coming from both the environment and the health angles) and are capable of evaluating integrative approaches. With regard to research on environmental health, participants noted that Horizon 2020 should build on existing networks of long-term cohort studies in Europe.

Key ideas

- Research under Horizon 2020 needs to make the leap from signalling problems to developing solutions. Providing incentives for innovation is key.
- Scientists need to move away from 'safe science', focussing more on the big unknowns.
- Trends in health care, in particular personalised prevention, match trends in EHWB research towards better understanding of multiple and lifelong individual exposure.
- The Exposome framework to explore linkages between environmental exposure and health might be used to demonstrate the co-benefits that arise from environmentally sustainable life styles.

[24] EU, 2006, Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH), establishing a European Chemicals Agency, amending Directive 1999/45/EC and repealing Council Regulation (EEC) No 793/93 and Commission Regulation (EC) No 1488/94 as well as Council Directive 76/769/EEC and Commission Directives 91/155/EEC, 93/67/EEC, 93/105/EC and 2000/21/EC, OJ L 396, 30.12.2006, p. 1–849.

Session 3: Bridging the Policy-Science-Assessments Gaps for EHWB

Building on the previous two sessions, this session involved a dynamic exchange of views and ideas between actors involved in the policy, science, research and assessment landscapes. An aim of the session was to identify pointers for future priority areas, cooperation and follow-up actions. The session was chaired by **David Stanners, EEA**, with a number of experts providing brief pitches on their priority areas and proposals for action.

Maria Betti, JRC, explained that the JRC had launched a project in May 2013 looking at climate change impacts on health via the environment, and assessing such aspects as the linkages between climate change, agriculture and nutrition. She noted that JRC was successfully collaborating with EEA, DG Environment, DG SANCO, the Food and Agriculture Organization (FAO) and the United Nations Environment Programme (UNEP) on a number of projects in the EHWB nexus. With regard to data collection, Ms Betti raised the question of how data might be collected and collated, providing the examples of Copernicus and the Information Platform for Chemical Monitoring (IPCheM).

Didier Gambier, Executive Agency for Small and Medium-sized Enterprises (EASME), stressed that the participation of SMEs would be needed in order to address Societal Challenge 5 of Horizon 2020 on Climate Action, Environment, Resource Efficiency and Raw Materials. He identified the LIFE programme as an important instrument for supporting projects in the EHWB nexus. He noted that in Horizon 2020 the Commission has not attempted to direct the scientific community's response to the challenges on the table, but has rather left it open to researchers to identify relevant solutions. In this way, scientists are encouraged to reflect on how their science can serve society.

Noting that public health has always been a complex policy issue that demands combined knowledge from both natural and social sciences, **George Morris, Scottish National Health Service**, said that the ecological transition is changing the game. He called for governance types that can manage, synthesise and respond to mixed evidence bases and support policies that effectively address complex systemic issues. Mr Morris introduced a tool for framing the complex relationships between environment and human health that was launched by the Scottish government in 2008, known as Good Places, Better Health. He described the tool as a framework for analysing multiple evidence types from different sources that can be used to define at the crux of the relationship between ecosystems services and well-being.

Hans Bruyninckx, EEA, explained that the ambition of the EEA is to participate in knowledge creation and understanding, in close coordination with the other knowledge creation facilities in the EU institutions. He expressed a commitment to establishing better links with other actors in the field of research, including those under Horizon 2020. He stated that a long-term perspective resonates well with EEA, both in terms of taking a historical perspective and looking forward to 2050. Recognising that discussions had centred on the interaction between environment and health with less emphasis on well-being, Mr Bruyninckx noted that well-being is harder to define and integrate into policies. He highlighted the importance of incorporating well-being into the policy agenda and into dialogue with the public.

Greet Schoeters, EEA Scientific Committee, welcomed the holistic systems approach to research on EHBW. Noting that examples are required to demonstrate the value of a systems approach to research, she highlighted human biomonitoring as a useful tool for signalling connections and for raising public awareness. She identified the value of a European network of human biomonitoring effectively combined with various on-going surveys (for example dietary surveys). She stated that people have the right to know what is in their bodies, and that this kind of knowledge can encourage people to demand action from policy makers. Ms Schoeters concluded by cautioning that to be of value, human biomonitoring data must be robust and comparable, based on harmonised standards, and that countries required incentives to produce such data.

Recognising the need to raise awareness of the opportunities environment, health and well-being research under Horizon 2020, **Arnd Hoeveler, RTD,** encouraged participants to multiple the message that applications dealing with environment and health issues are welcome under Societal Challenge 1 and that Horizon 2020 is quite open to new ideas and ready for new approaches. Noting that the 21st Century is about complexity, he encouraged researchers to work at a level of complexity that we can handle, suggesting that given the number of stakeholders involved, a stepwise and coordinated approach is needed. A broader scale action jointly with Member States and other actors, combining different resources (including e.g. structural funds) may be a way to showcase how EHWB research can be tackled. He also reiterated the importance of ensuring the quality of data.

Kurt Vandenberghe, RTD, explained that Horizon 2020 is intended to be a break with the past and to be stakeholder led and recognised that this change involves challenges as well as opportunities. RTD will ensure that these opportunities are visible. Identifying Horizon 2020 as a driver of sustainable development and the development of a green economy, he said that DG RTD will work with colleagues to ensure a coherent approach across the Commission and EU agencies (including ENV, ENTREPRISE, CLIMA, EASME, JRC, ESTAT and the EEA). He committed to both supporting and challenging the scientific community to evolve, be transparent, work across disciplines, frame issues and remain socially relevant in telling important stories. He stressed the need to work collaboratively to ensure that Horizon 2020 delivers both outcomes and impacts relevant for society. He will follow up on this workshop in particular by deepening relations with his RTD colleagues in charge of Societal Challenge 1. As for Societal Challenge 5, he welcomed new ideas on topics related to ecosystems, well-being and nature-based solutions for future programming.

David Stanners, EEA, identified the work on Late Lessons as a systemic pillar of the EEA workplan where EHWB issues are addressed and expressed the need to continue the work with a forward looking mind-set.

In the following **discussions**, the importance of effective science-policy interfaces, and the need to work with boundary organisations was emphasised. It was suggested that it may be time for an environment and human health communication initiative in Europe.

On capturing well-being, a participant stressed the need to look not just at disease outcomes but also at maintaining functions, noting that children's blood lead concentrations at levels below current exposure limits have been associated with lower school performance and behavioural issues.

With regard to monitoring data, participants considered how to ensure that data is policy-relevant, establish partnership for long-term health monitoring and make data publically accessible. Developing epigenetic programming involves more than merely building an infrastructure, it also means for instance taking blood samples from children today so that we have them available in 2020 and in 2050.

Concluding Remarks

Mr Cocco and **Mr Bruyninckx** then provided some concluding remarks.

Mr Cocco reiterated the need for routine surveillance and infrastructures for environment and health data. He recalled that we will continue to have to act on health issues even when full understanding of mechanistic causality is absent; in other words, we have to live with unknowns. He suggested that the knowledge producers should by-pass law makers and reach out to the public to communicate information on environmental threats in a reasoned way.

To Mr Bruyninckx, this seminar was about reinventing what the 'good life' is. Noting that the 20th Century paradigm of modernity did not take environmental issues and limits seriously, he explained that the objective of the 7EAP of living well within the limits of the planet represents a radically different agenda that demands a transition in our relationship with the environment. He argued that this transition is both a political and a social project that involves setting a new agenda for communities. This project must be based on a common societal understanding of the current status quo and possible pathways forward, presenting a challenge in terms of generating the required knowledge base and effectively communicating that knowledge to the public.

Overall Reflections

The seminar set out to meet four objectives, as set out in the introductory section. In the section below, we briefly consider how the seminar addressed these objectives and draw out key messages. We then consider the implications for future actions to address societal challenges and promote the transition agenda, as well as the needs for institutional collaboration in support of these priorities.

Reflections on the Seminar Objectives

1. Clarify the EHWB objectives of the EEA and their relevance to the implementation and visions of relevant EU policies, for both the 2014-2020 and the 2020-2050 perspectives.

The seminar participants called for EEA assessments that move away from compartmentalised hazard-based approaches towards an integrated systemic perspective on the complex relationship between the environment, human health and well-being. Broader assessment frameworks are needed to address social factors such as inequality and impacts on well-being (both positive and negative). The participants identified initiatives and tools that can facilitate such systemic assessments by providing both qualitative and quantitative information, including for example, FRESH, mDPSEEA and Good Places Better Health. There was support for continued EEA work under the Late Lessons framework, aimed at better assessment of emerging issues and handling of risks. Seminar participants called for assessments that include a thorough treatment of uncertainties, including reflections on the degree of ignorance, to allow politicians to take better balanced and informed decisions.

Seminar discussions also touched on the value of story-telling in communicating messages to policy makers and the public in order to encourage their participation in decision making. These stories should incorporate future scenarios in order to resonate with the public and stimulate engagement. In targeting policy makers, EEA assessments should highlight potential co-benefits from possible actions, whereby mitigation and/or improvement efforts in one area can yield additional benefits in another area. With regard to the 2020-2050 perspective, it was argued that EEA assessments should identify the multiple factors that are driving environmental pressures and related health and well-being impacts, and consider what transitions would be needed to reduce these. In doing so, the EEA would generate knowledge to inform the development of coherent, cross-sectoral policies that can catalyse long-term transitions towards a sustainable relationship with our environment.

2. Consider the knowledge requirements to support assessments on EHWB by EEA ([25]) and partner institutions (e.g. Joint Research Centre (JRC), World health Organization (WHO)) and how to accelerate the development of this knowledge over the period 2014-2020.

Participants argued that research design should focus much more on systemic approaches that involve inter-disciplinary teams and embrace multi-causality to untangle EHWB linkages over broad temporal and spatial scales. The need for a rigorous analytical approach and transparency of methods and results was stressed. It was suggested that such research can draw on available secondary evidence from across multiple disciplines and combine it in new ways to provide a systemic perspective.

The value of traditional science, deepening the knowledge of relatively well-studied issues, was acknowledged in this respect, but there is also a need to focus more on the big unknowns. For this, scientific researchers would need to embrace new evidence types and address emerging risks. Biomedical research, for example, could put more emphasis on vulnerable life stages, individual susceptibility, and delayed or long term effects and complex exposures. In terms of accelerating knowledge development over the 2014-2020 period, seminar participants flagged the importance of communication between the scientific and assessment communities in order to clearly identify knowledge needs for both short- and long-term policy perspectives.

3. Address the multiple interfaces between policy and science in the EHWB area and how knowledge can be further aligned to policy needs through Horizon 2020 strategic programming and activities and FP7 follow-up activities.

To underline current imperfections in the science-policy interface, examples were given where robust evidence of adverse health effects has not yet been acted upon at the political level. The role of public awareness was stressed in a governance context where policy makers seek consensus on complex EHWB issues that involve plural values, trade-offs, unevenly distributed costs and benefits and powerful vested interest groups. Seminar participants called on researchers to make the leap from signalling problems to developing solutions. They also considered the types of evidence that are required to support policy making and what makes evidence legitimate. They considered the need to allow a wider range of evidence to be pulled into the policy making process. Recognising that economic arguments carry significant weight, participants considered the merits and limitations of cost-benefit analysis, and ways to bring non-monetary values to the fore.

Representatives from DG RTD expressed a commitment to using Horizon 2020 to promote systemic knowledge generation and to improve collaboration both amongst policy makers and with other stakeholders in mapping out research needs. Participants considered whether Horizon 2020 can be used to focus more on emerging risks and unknowns. Recognising the value of a systemic framework under Horizon 2020, it was suggested that a grand narrative be developed to provide overall guidance and help researchers to see how their niche work sits within a wider framework. Collaboration across the Horizon 2020 Societal Challenges, in particular Societal Challenge 1 (health) and Societal Challenge 5 (environment), was stressed as crucial in this context.

[25] As foreseen under Strategic Area 2.2 of EEA's 2013, *Multi-Annual Work Programme: Assessing Systemic Challenges – Environment, human health and well-being*.

4. Identify options over the period 2014-2020 and beyond for using EU instruments (e.g. Horizon 2020, Life+, SEIS, Inspire, Copernicus) to design and implement efficient and harmonized EHWB monitoring systems across Europe.

The presentations at the seminar focused on air quality monitoring, biomonitoring of chemical body burdens and monitoring pollen concentrations. Participants were briefed on the potential for linking different sources of monitoring data in order to identify EHWB linkages through the use of geomedicine tools and monitoring an individual's lifetime exposure through the Exposome approach. Parallels and potential synergies with the development of personalised prevention and care in the health care sector were highlighted.

In particular, participants considered how Horizon 2020 might provide support to the development of a Europe-wide human bio-monitoring programme that would build on COPHES and DEMOCOPHES to generate robust and comparable data based on standardised methods and analyses. It was recognised that countries require incentives to participate in programmes to produce comparable data. The development of the Information Platform for Chemical Monitoring (IPCheM) was discussed as another example of how monitoring data from multiple media might be collated to inform an understanding of overall exposures. The potential of Copernicus as a useful tool for communicating with the public was highlighted.

Future Perspectives

Addressing Societal Challenges

With regard to improving the evidence base for assessments and policies in the EHWB nexus, Horizon 2020 is no doubt a major opportunity. Of the seven Societal Challenges it aims to address, two explicitly refer to EHWB issues: Societal Challenge 1 on Health, Demographic Change and Well-being and Societal Challenge 5 on Climate Action, Environment, Resource Efficiency and Raw Materials. It should be stressed, however, that EHWB aspects feature (implicitly) in all the societal challenges. The long-term perspective and the transitions towards more sustainable systems are particularly pronounced in Societal Challenge 2 on Food Security, Sustainable Agriculture and Forestry, Marine, Maritime and Inland Water Research and the Bio-economy, Societal Challenge 3 on Secure, Clean and Efficient Energy, and Societal Challenge 4 on Smart, Green and Integrated Transport. Inequality, social exclusion, economic crisis and unemployment, as well as opportunities offered by new forms of innovation and citizens' engagement are the core of Societal Challenge 6 on Europe in a changing world – Inclusive, innovative and reflective societies, while the protection of society, economy, and infrastructures, political stability and well-being is addressed in Societal Challenge 7 on Secure societies – Protecting freedom and security of Europe and its citizens.

Strengthening collaboration among the Horizon 2020 Societal Challenges, strongly supported by seminar participants, is crucial to exploiting potential synergies in improving the health and well-being of the ageing European population in an inclusive manner, taking account of environmental and climate concerns, with a long-term transition perspective on resource use, food, energy and

transport systems. An integrative approach to EHWB that involves inter-disciplinary teams and embraces multi-causality to untangle linkages over broad temporal and spatial scales necessitates collaboration across Societal Challenges. A shift in attention from cure to prevention, including the role of nature, would stimulate further innovation and contribute to meaningful job creation, as well as yielding macro-economic benefits in terms of reduced healthcare costs.

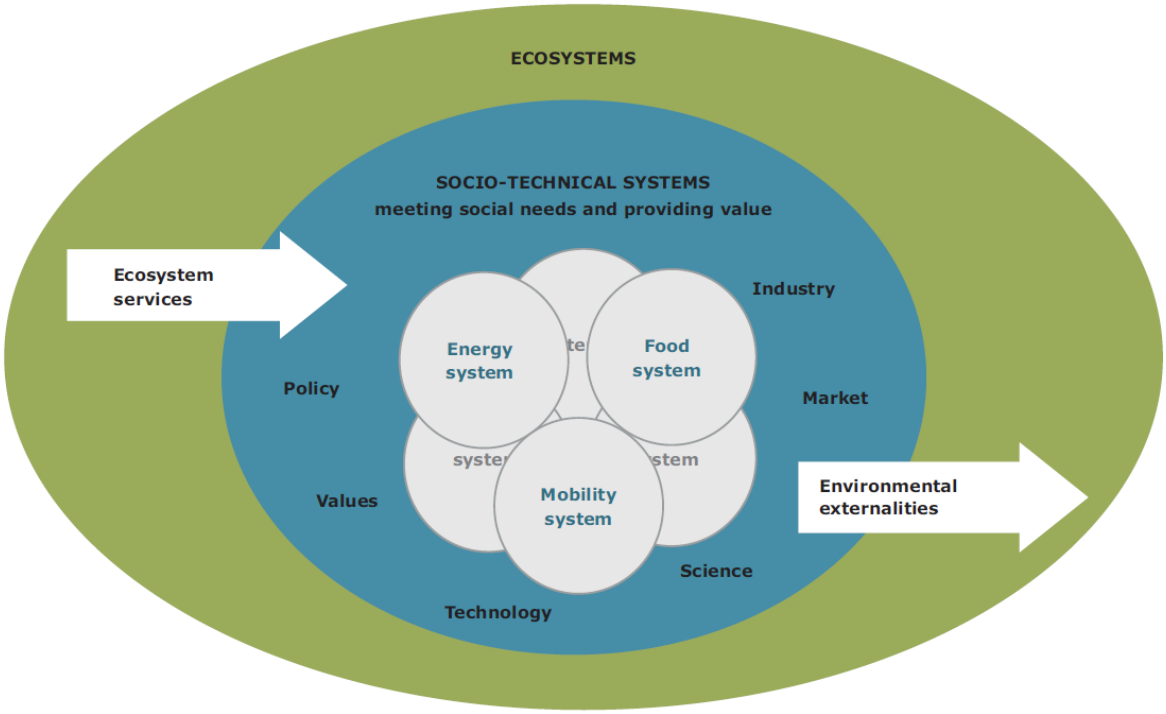
Technological progress in personalised healthcare, including the development of mobile tools, sensors, wearable devices and ICT-supported systems for monitoring and interventions, is expected to support the integration of multiple parameters, such as biomedical, environmental, and human bio-monitoring data, to inform personalised decisions. The new 'exposome' approach to monitoring an individual's overall exposure across different life stages offers considerable promise in this context. Integration of different sources of knowledge and data is expected to contribute to more effective prevention, earlier detection and improved disease management. In addition to benefiting population health, these developments can also play a role in transforming health and care systems towards more sustainable, effective and efficient models.

Drawing on evidence from multiple disciplines and across Societal Challenges, a systemic perspective on EHWB should contribute to reducing current imperfections in the science-policy interface through delivering robust evidence to underpin decisions and actions. Such a perspective should also challenge the silo approach in decision-making and foster integration across policy sectors.

Supporting the transition agenda

Very relevant in this context is the 2050 vision that is captured in the 7EAP entitled *Living well, within the limits of our planet*, centred on ecological limits, a circular and green economy and society's resilience (Figure 15). The overall aim of the 7EPA is to step up the contribution of environmental policy to the transition towards a resource-efficient, low-carbon economy in which natural capital is protected and enhanced, and the health and well-being of citizens are safeguarded. The EEA supports this long-term vision under strategic area 2, *Assessing systemic challenges*, of its 2014-2018 Multi-Annual Work Programme.

Figure 15: Living well within ecological limits



Source: EEA, 2013, *Multi-Annual Work Programme: Assessing Systemic Challenges – Environment, human health and well-being*, European Environment Agency, Copenhagen, Denmark.

Eco-innovation is a central theme here, and will be required in all major 'socio-technical' systems that determine the use of natural resources, and the associated environmental pressures and health and well-being impacts (see Figure 15). In 2011, the European Commission launched an Eco-innovation Action Plan ([26]), establishing ambitious standards, targets and capacity building mechanisms, such as European Innovation Partnerships. Horizon 2020 has great potential to improve the knowledge base and boost such eco-innovation processes, with potentially positive outcomes across all seven Societal Challenges.

Eco-innovation does not necessarily imply only technological innovation, but can also refer to system innovations with behavioral, social, institutional and spatial dimensions. The potential for spatial innovations is particularly evident in the food, transport, housing and social systems, where 'smart grids' and 'green infrastructure' can improve both resource efficiency and health and well-being outcomes. International cooperation and networking is crucial in this respect, and will require the development of trans-boundary planning concepts, as well as innovation in governance mechanisms. Nature-based solutions have the potential to address Societal Challenges, in particular those related to EHWB.

[26] EC, 2011, Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, 'Innovation for a sustainable Future - The Eco-innovation Action Plan (Eco-AP)', COM/2011/0899 final.

Institutional networking

Integrating EHWB horizontally across the seven Societal Challenges of Horizon 2020 and ensuring that the EHWB perspective shapes longer term objectives up until 2050 will require effective collaboration across institutions involved in research, assessments and policy making. Research centres, agencies and policy makers should view their work through a common lens and ensure that the EHWB thread runs from the early stages of monitoring, through systemic assessments and is woven into policy making across all relevant domains. This demands effective communication and cooperation up and down the knowledge value chain, as well as horizontally amongst actors involved in each step.

Cross-disciplinary partnerships in research can catalyse the exchange of new monitoring techniques, promote data and information sharing and allow for the cross-fertilisation of ideas. Funding instruments such as the EU's LIFE Programme, as well as public-private partnerships, can support the development of new approaches to combining data on health and well-being with data on both environmental exposures and positive environmental experiences. Analysis across data sets can generate a broad knowledge base that captures the systems perspective. This can contribute to improving environmental integration and policy coherence, a priority objective of the 7EAP.

Local, national, European and global institutes and agencies can establish partnerships to undertake assessments at multiple scales, generating a rich evidence base for policy making. Through Eionet, the EEA is well placed to capture evidence from the national level and position it within a wider European framework, while partners such as WHO and UNEP can then place this within a global perspective. Such multi-scale assessments can then be unpacked to explore the implications of EHWB policies at global level, at regional level, at national level and at the local level. The balance between the pros and cons of particular policies will shift depending upon the spatial and temporal scale over which assessments stretch, with long temporal horizons of particular importance to capturing health and well-being aspects.

Finally, EU policy makers need to reach across domains and construct more space for thinking about how EHWB spills across the administrative borders of the Directorates-General. The EHWB lens can be used to identify potential synergies across policy areas. The demand for knowledge to clarify how these synergies might be better exploited should then be communicated back to those institutions and agencies involved in research and assessments.